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Small mammal populations in a restored stream corridor

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Abstract

An opportunity to study the response of a small mammal community to restoration of a riparian wetland was provided by the Pen branch project at the Savannah river site (SRS). Live trapping of small mammals was conducted on six transects at Pen branch in 1996 and 1998 and at three transects at Meyers branch, an unimpacted stream at SRS, in 1997 and 1998. Distributions of rates of capture of the four most common species were both spatially and temporally uneven. Kruskal–Wallis one-way analysis of variance revealed no significant differences in the relationship of capture rates between species and between treatment and both the within-stream control and Meyers branch. Habitat use and movement within stream corridors appears to be dependent primarily on species, with age and sex perhaps contributing to habitat preference and distance moved. The lack of differences in capture rates related to transect or treatment may be due to the close proximity of sample transects relative to the movement potential of the species sampled.

Keywords: Small mammals; Wetland restoration; Riparian habitat

1. Introduction

In the southeastern US, small mammal populations associated with riparian wetlands have not been widely studied (Mitchell et al., 1993, 1995; Thurmond and Miller, 1994) and information on the response of these populations to restoration of impacted wetland areas has not been widely published. Small mammal communities in the Southeast are somewhat depauperate in numbers of species (Kolka et al., 1998 and Table 1). In the region where this study was conducted, e.g. there are only ten commonly occurring species of murid rodents.

The opportunity to study the response of a small mammal community to restoration of a riparian wetland was provided by the Pen branch project at the Savannah river site (SRS) (Fig. 1). As a receiving stream for reactor effluent, Pen branch underwent dramatic changes between 1954 and 1988. Greatly increased flows and high temperatures severely altered all aspects of the stream

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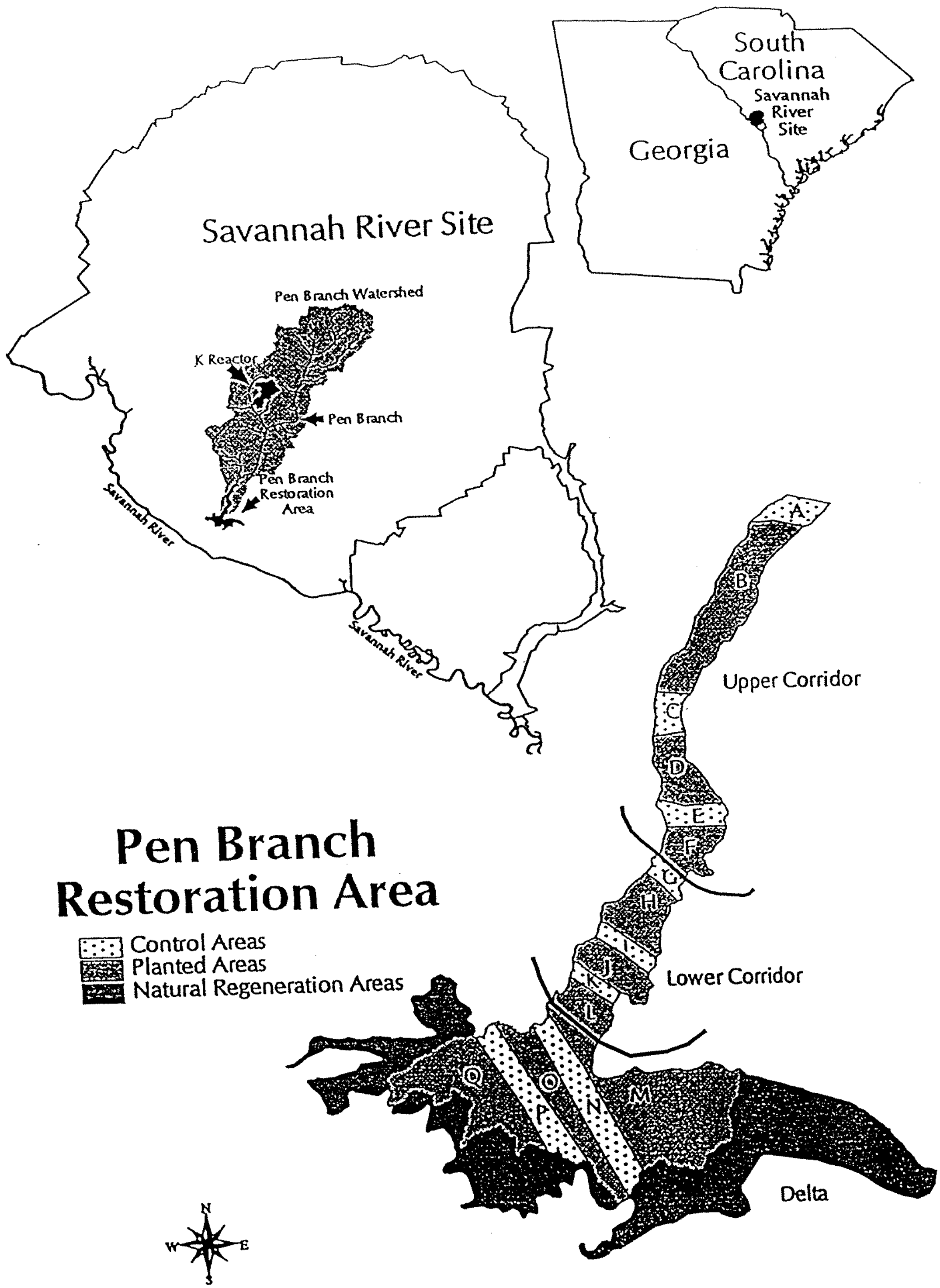

Fig. 1. Map of the SRS and the Pen branch restoration area (from Kolka et al., 1998).

corridor. When reactor operation ceased in 1988, natural processes began to influence the area and establish communities within the corridor. Remediation efforts began in 1992 and many programs were initiated to evaluate response of the various biotic communities.

As an important part of the food chain, small mammals serve as the main link between primary production and higher level consumers in the local ecosystem. In a riparian system, higher level consumers are represented by a wide variety of predators including large snakes, various aquatic and semi-aquatic carnivores, and raptors. Rapid turnover in small mammal populations influences the transfer of nutrients and energy from localized vegetative production into more mobile organisms

Table 1
Comparisons of numbers of native species of murid rodents in various geographic units[a]

Species	SRS site[b]	Carolinas[c]	Southeastern US[d]	Texas[d]
Baiomys taylori				×
Clethrionomys gapperi		×	×	
Microtus chrotorhinus		×	×	
M. mexicanus				×
M. ochrogaster				×
M. pennsylvanicus		×	×	
M. pinetorum	×	×	×	×
Neofiber alleni			×	
Neotoma albigula				×
N. floridana	×	×	×	×
N. micropus				×
Ochrotomys nutalli	×	×	×	×
Ondatra zibethicus	×	×	×	×
Onychomys leucogaster				×
O. torridus				×
Oryzomys palustris	×	×	×	×
Peromyscus boyeli				×
P. difficilis				×
P. eremicus				×
P. floridanus			×	
P. gossypinus	×	×	×	×
P. leucopus	×	×	×	×
P. maniculatus		×	×	×
P. pectoralis				×
P. polionotus	×	×	×	
P. truei				×
Reithrodontomys fulvescens				×
R. humulis	×	×	×	×
R. megalotis				×
R. montanus				×
Sigmodon hispidus	×	×	×	×
S. ochrognathus				×
Synaptomys cooperi		×	×	
Number of species	10	15	17	26

[a] For the purpose of this comparison the southeastern US is defined to extend from Virginia and Tennessee south to include Florida. Texas was chosen for a comparison with the southeastern US because it is at about the same latitude, shares much of the same flora and fauna, and has a comparable area.

[b] Cothran et al., 1991.

[c] Webster et al., 1985.

[d] Burt and Grossenheider, 1976.

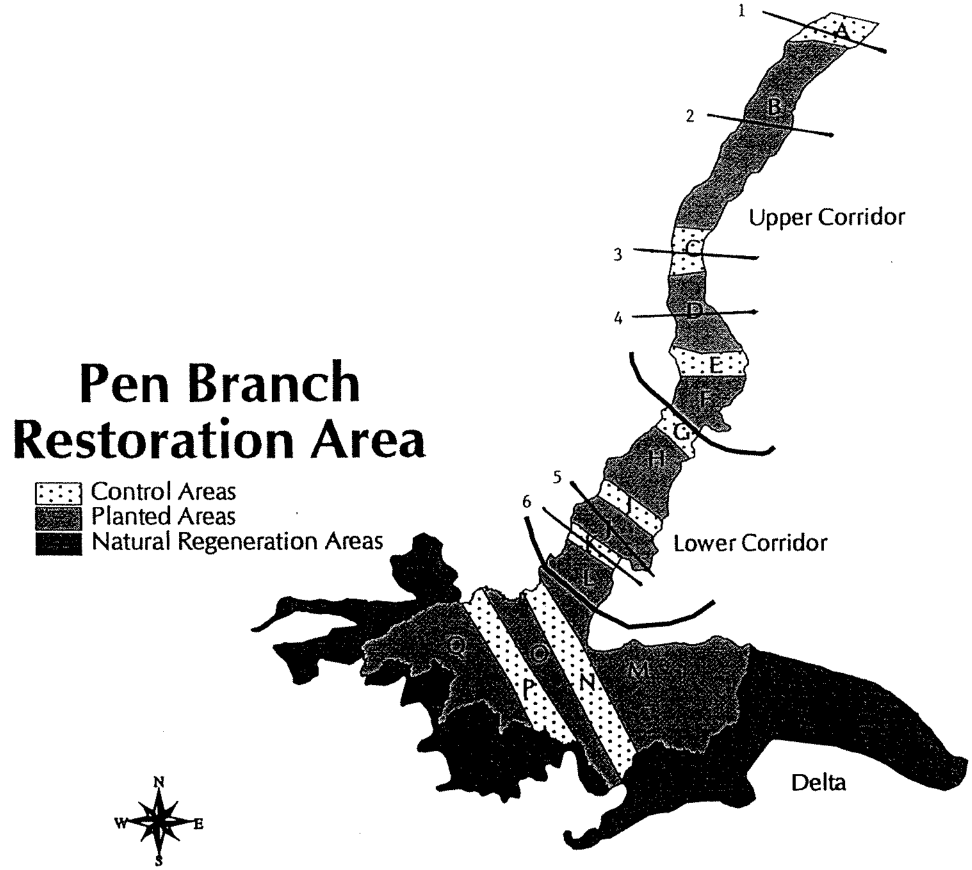

Fig. 2. Locations of the small mammal trapping transects in the Pen branch restoration area (modified from Kolka et al., 1998).

that range widely throughout the regional landscape.

We compared the response of small mammal populations between manipulated experimental areas, control areas allowed to follow the course of localized succession, and an undisturbed portion of Meyers branch, which served as a baseline. Because our trapping efforts primarily captured murid rodents, our analyses are focused on these taxa.

2. Materials and methods

Small mammal trapping was conducted at Pen branch in 1996 and 1998. Trapping at Meyers branch took place during 1997 and 1998. Resources were not available to trap both areas in 1996 and 1997. Trapping was conducted for 18 consecutive days and began on 11 June in 1996, 22 July in 1997, and 16 June in 1998. At Pen branch six transects were established corresponding to the reptile and amphibian sample lines (Kolka et al., 1997) at locations indicated in Fig. 2. Lines were numbered from 1–6 and lines 1, 3, and 6 were in control areas while lines 2, 4, and 5 were in treatment zones (Fig. 2). Eight sample points, labeled A–H were established on each transect. In 1996 each of the sample points roughly coincided with coverboard arrays established by the reptile and amphibian sampling program. In 1998 the coverboard arrays no longer existed, but sample points were placed in the same general locations. During both years, wooden live trap 'rabbit boxes' were placed at the ends and center of each transect to determine the presence or absence of mammals such as rabbits, raccoons, and opossums. At Meyers branch, three trap lines were established with six sample points on each line. At Pen branch, each transect began and ended in the adjacent riparian forest, the lines at Meyers branch began in the adjacent woodland but did not cross the entire flood plain. In all years and at both streams, four Sherman® live traps were placed at each sample point. Traps were baited with a mixture of birdseed, sunflower seed, oats, and peanut butter. Traps were checked each day for 18 consecutive days. Captured animals were identified to species, weighed on appropriate capacity spring scales, sexed, and marked before release. In 1996 and 1997 animals were marked by being fitted with numbered ear tags for individual identification. In 1998 animals were toe-clipped for capture location but not individual identification. During the study, 2592 trap nights were accumulated at Meyers branch and 6840 at Pen branch. The Kruskal–Wallis one-way analysis of variance of the data was performed using SYSTAT 7.0©.

3. Results

The only species which were captured in numbers sufficient for statistical analysis were the four murid rodents, the eastern woodrat (*Neotoma floridana*), the marsh rice rat (*Oryzomys palustris*), the cotton mouse (*Peromyscus gossypinus*) and the hispid cotton rat (*Sigmodon hispidus*). All other species either were represented by fewer than ten individuals or were only observed and not actually captured. Table 2 contains a list of the small mammal species that we encountered during this study.

Rates of capture of animals were both spatially and temporally uneven. For the four most common species at Meyers branch capture rates were lower in 1997 than in 1998. At Pen branch, capture rates for rice rats and cotton rats were higher in 1996 as compared to 1998, whereas the reverse was true for woodrats and cotton mice (Table 3). For woodrats, capture rates were much higher for Meyers branch than for Pen branch while for cotton rats the opposite was the case. There is no apparent pattern in captures for rice rats and cotton mice. Kruskal–Wallis one-way analysis of variance revealed no significant differences in capture rates of any species either between creeks or among transects within a creek.

Because the four species we most frequently captured have quite different habitat requirements, we examined the distribution of captures relative to distance from the streams (Table 4). There was no easily discernable pattern for woodrats. Rice rats were captured most frequently one or two stations away from the stream channel while cotton rats were captured most frequently two stations away from the stream

Table 2
Species of small mammals captured or observed during this study[a]

Species	Common name	Observed or captured	Number of captures
Blarina carolinensis	Southern short-tailed shrew	C	8
Condylura cristata	Star-nosed mole	C	1
Didelphis virginiana	Virginia opossum	C	3
Neotoma floridana	Eastern woodrat	C	32
Ochrotomys nuttali	Golden mouse	C	1
Oryzomys palustris	Marsh rice rat	C	225
Peromyscus gossypinus	Cotton mouse	C	406
Procyon lotor	Raccoon	O	0
Sigmodon hispidus	Hispid cotton rat	C	174
Sylvilagus floridanus	Eastern cottontail	O and C	1

[a] Number of captures is for all years and includes recaptures.

Table 4
Distribution of captures along the transects [a]

	Trapping stations							
	A	B	C	D	E	F	G	H
Meyers branch (1997)								
N. floridana	1	1	4	0	3	0		
O. palustris	0	0	0	0	2	2		
P. gossypinus	2	6	3	14	4	12		
S. hispidus	0	0	0	0	0	0		
Meyers branch (1998)								
N. floridana	1	3	6	3	2	4		
O. palustris	0	5	2	12	12	9		
P. gossypinus	24	22	15	20	7	30		
S. hispidus	0	0	1	0	1	2		
Pen branch (1996)								
N. floridana	0	1	0	0	0	0	0	0
O. palustris	3	19	28	17	17	20	9	1
P. gossypinus	49	22	4	3	3	10	2	19
S. hispidus	2	4	41	16	22	33	11	19
Pen branch (1998)								
N. floridana	1	0	0	0	0	1	0	1
O. palustris	2	7	8	9	16	11	9	5
P. gossypinus	49	7	4	7	6	11	12	39
S. hispidus	0	4	10	2	5	1	0	0

[a] Because sampling effort was the same for all stations within any given combination of creek and year, raw numbers of captures are reported. At Pen branch station A was the station closest to the access road and the last station was placed in the woods across the creek from the access road. There were even numbers of station on each side of the creek. At Meyers branch, the transect did not go completely across the floodplain. In 1997 station F was the only station across the stream while in 1998 both station E and F were across the stream.

4. Discussion

The four species considered in our study vary greatly in their habitat preferences. The rice rat primarily is a marsh or swamp species that occasionally goes into nearby grasslands to feed. The cotton rat is a grassland or oldfield species and the woodrat and cotton mouse primarily are woodland species which readily utilize bottomlands and swamps (Webster et al., 1985).

Suitable habitat for cotton rats was fragmented in the Pen branch corridor. This may have had an effect on the frequency of movements and distances moved. Diffendorfer et al. (1995) reported that when patches of suitable habitat for cotton rats are large, movement distances are moderate. In that study smaller patches resulted in larger movement distances, but very small patches (32 m^2 patch size) were mostly not utilized.

Subadult male cotton rats appear more likely to use wetlands than adults of either sex or subadult females (Lidicker et al., 1992). For our data and for those individuals with gender identified, the sex ratios for cotton rats were 2.8 male:1 female in 1996 and 1.8 male:1 female in 1998. While this may be indicative of the higher probability of subadult males to occur in wetlands, there were large number of animals for which gender was not determined.

No significant differences were found in capture rates of any species that related to either trapping transect or treatment. The control areas for Pen branch are only 100–150 m wide and the entire Pen branch study area was approximately 2.5 km in length. The degree of movement among transects together with the variances in trapping rates

Table 5
Combined numbers of captures of ear-tagged individuals for both creeks and the percentage of these captures that represented first time captures[a]

Species	Year	Number of individuals tagged	Number of captures	Percent first time captures
N. floridana	1996–1997	8	12	66.7
O. palustris	1996	50	98	51.0
	1997	3	5	60.0
P. gossypinus	1996	48	105	45.7
	1997	19	39	48.7
S. hispidus	1996	69	133	51.9

[a] Because of low numbers of captures, woodrats are combined for 2 years while the others are reported for specific years.

Table 6
Numbers of captures of ear-tagged individuals comparing the locations of subsequent recaptures with the location of the immediately previous capture

Species	Number of subsequent captures	Next capture occurring at same trap station	Percent captures at same trap station as previous
O. palustris	49	25	51.0
P. gossypinus	77	50	64.9
S. hispidus	59	44	74.6

Table 7
Comparisons of animals from both Pen branch and Mayers branch captured more than once with the numbers wandering as far as another transect

Species	Animals captured more than once	Number of wanderers	Percent wanderers
O. palustris	36	2	5.6
P. gossypinus	28	1	3.6
S. hispidus	24	2	8.3

may be enough to obscure any predicted differences. This is consistent with the literature. Pournelle (1950) in Wolfe and Linzey (1977) reported movements by individual cotton mice of up to 853 m with average movements 145 and 115 m by males and females, respectively. Cotton rats in other studies showed much less movement. Cameron et al. (1979) in Cameron and Spencer (1981) reported average daily movements of only 13 m. Debusk and Kennerly (1975) in Cameron and Spencer (1981) reported that cotton rats displaced up to 300 m still were on familiar territory and thus still able to home easily. While most of the cotton rats in our study moved little if at all, certain individuals moved large distances with one being captured at both transects 1 and 2.

While habitat fragmentation influences amount of movement and distances moved, habitat type has little effect on movement distances for cotton rats. Slade and Swihart (1983) reported comparisons between pasture and old field habitat which revealed significant effects on movements in adult males and juvenile females but not for adult females, juvenile males or subadults of either sex. However, they did report that a dirt road running between the two habitat types was a very effective barrier to movements. The differences in habitat within the Pen branch corridor probably were smaller than between pastures and old fields.

Stafford and Stout (1983) showed that dispersal in cotton rats, as opposed to ordinary movement, was not influenced by gender or by size class. We cannot say for sure whether our larger movements were ordinary movements or dispersal, but no sex or body size dominated.

A factor that might have influenced the species composition of our samples was delayed response to traps by individuals of a particular species. Our traps only took a few short-tailed shrews and golden mice. Both of these species have been shown to be trap neophobic (Smith et al., 1980) and, had we extended the sampling period a few more days each year, might have been better represented in our samples.

5. Conclusion

Small mammal movement capacities have proved to be too large for our analysis to show differences among the treatments analyzed here. Further studies at larger scales, possibly augmented by radiotelemetric methods might prove valuable in ascertaining the effects of different treatments upon the dynamics of small mammal populations in restored wetlands. However, the small mammal community may be a poor choice for monitoring recovery of wetlands where the habitat areas are very small.

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